

## CLAIMS

We claim:

1 1. A method of geophysical exploration of a subsurface region of interest, comprising:  
2 utilizing an unsupervised learning network to organize seismic data representing a  
3 subsurface region of interest;  
4 correlating a portion of said organized seismic data with lithological data from a  
5 well bore located in said subsurface region of interest; and  
6 applying said correlation to said seismic data to estimate lithology in said subsurface  
7 region of interest.

1 2. The method of claim 1 wherein said unsupervised learning network is a self  
2 organizing feature map.

1 3. The method of claim 1 wherein said unsupervised learning network is a Kohonen  
2 network.

1 4. A method of geophysical exploration of a subsurface region of interest, comprising:  
2 applying a plurality of seismic data attributes for measurement location from a  
3 seismic data set from a subsurface region of interest to a Kohonen network to organize said  
4 seismic data set into a plurality of seismic Kohonen classes;  
5 selecting a subset of said organized seismic data set representative of the earth's  
6 subsurface in the vicinity of a well bore penetrating said subsurface region of interest;  
7 correlating Kohonen classes of said subset of said organized seismic data set with  
8 classes of lithological data from said well bore to generate a correlation between Kohonen  
9 classes and lithological classes; and  
10 applying said correlation to said seismic data set to estimate lithology of said  
11 measurement locations.

1        5        The method of claim 4 wherein said seismic data attributes comprise semblance,  
2        amplitude-versus-offset and attenuation.

1        6.        The method of claim 4 wherein said lithological data comprise volume shale and  
2        acoustic impedance.

1        7.        A method of geophysical exploration of a subsurface region of interest, comprising:  
2        applying a plurality of lithology values for measurement location from a well bore  
3        penetrating a subsurface region of interest to a Kohonen neural network to organize said  
4        lithology values into a plurality of lithology Kohonen classes;  
5        utilizing said lithology Kohonen classes to establish ranges of a lithology value;  
6        applying a plurality of seismic data attributes for measurement location from a  
7        seismic data set from said subsurface region of interest to a Kohonen network to organize  
8        said seismic data set into a plurality of seismic Kohonen classes;  
9        selecting a subset of said organized seismic data set representative of the earth's  
10       surface in the vicinity of said well bore penetrating said subsurface region of interest;  
11       correlating Kohonen classes of said subset of said organized seismic data set with  
12       classes of lithological data from said well bore to generate a correlation between Kohonen  
13       classes and lithological classes, wherein said ranges of a lithology value are utilized in  
14       establishing boundaries of said lithology classes; and  
15       applying said correlation to said seismic data set to estimate lithology of said  
16       measurement locations from said subsurface region of interest.

1        8.        The method of claim 7 wherein said lithology values are volume shale and acoustic  
2        impedance.

1        9        The method of claim 7 wherein said seismic data attributes comprise semblance,  
2        amplitude-versus-offset and attenuation.

10. A device which is readable by a digital computer having instructions defining the following process and instructions to the computer to perform said process:

- utilizing an unsupervised learning network to organize seismic data representing a subsurface region of interest;
- correlating a portion of said organized seismic data with lithological data from a well bore located in said subsurface region of interest; and
- applying said correlation to said seismic data to estimate lithology in said subsurface region of interest.

11. A device which is readable by a digital computer having instructions defining the following process and instructions to the computer to perform said process:

- applying a plurality of seismic data attributes for measurement location from a seismic data set from a subsurface region of interest to a Kohonen network to organize said seismic data set into a plurality of seismic Kohonen classes;
- selecting a subset of said organized seismic data set representative of the earth's subsurface in the vicinity of a well bore penetrating said subsurface region of interest;
- correlating Kohonen classes of said subset of said organized seismic data set with classes of lithological data from said well bore to generate a correlation between Kohonen classes and lithological classes; and
- applying said correlation to said seismic data set to estimate lithology of said measurement locations.

12. A device which is readable by a digital computer having instructions defining the following process and instructions to the computer to perform said process:

- applying a plurality of lithology values for measurement location from a well bore penetrating a subsurface region of interest to a Kohonen neural network to organize said lithology values into a plurality of lithology Kohonen classes;
- utilizing said lithology Kohonen classes to establish ranges of a lithology value;

7 applying a plurality of seismic data attributes for measurement location from a  
8 seismic data set from said subsurface region of interest to a Kohonen network to organize  
9 said seismic data set into a plurality of seismic Kohonen classes;

10 selecting a subset of said organized seismic data set representative of the earth's  
11 surface in the vicinity of said well bore penetrating said subsurface region of interest;

12 correlating Kohonen classes of said subset of said organized seismic data set with  
13 classes of lithological data from said well bore to generate a correlation between Kohonen  
14 classes and lithological classes, wherein said ranges of a lithology value are utilized in  
15 establishing boundaries of said lithology classes; and

16 applying said correlation to said seismic data set to estimate lithology of said  
17 measurement locations from said subsurface region of interest.